

RAPTOR RESEARCH



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RAPTOR REHABILITATION AT THE OKLAHOMA CITY ZOO

by

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Abstract

A program of raptor rehabilitation has been conducted at the Oklahoma City Zoo in an effort to conserve wildlife, to assist the public, and to gain knowledge about the care and treatment of injured birds. From October 1973 through December 1974 Red-tailed Hawks and Great Horned Owls constituted 45.3 percent of all birds donated. Donations from the public comprised 89.0 percent of the birds treated. Wing injury was found in 52.0 percent; radiographs showed that 22.7 percent of all cases involved gunshot. Binding of the limb with Vetrap^R, following surgery (where indicated) with ketamine anaesthesia (ca. 33 mg/kg), followed standard medical procedures. While recuperating, birds were kept quiet in small, dark containers, and fed on a whole animal diet. To reduce muscle atrophy and loss of condition, release was attempted as soon as possible. Large high cages, high perches, falconry techniques, and the assistance of local falconers all contributed to preparations for release. The release rate of 39.6 percent compared favorably with figures given for other rehabilitation projects.

There is a discussion of the need for more public education in raptor ecology and more exchange of information among rehabilitators. Techniques—the use of tranquilizers with anesthetics, practice in hunting before release, and banding, for example—are also discussed.

Introduction

The past two decades have been marked by man's increased awareness of his environment and concern for its stability. This "ecological consciousness" is perhaps nowhere better exemplified than in his concern for the well-being of predators, long considered his enemies. Partly because of their unique position as indicators of environmental pollution by pesticides, the birds of prey, often called raptors, have played a major role in the environmental issue.

In 1965 a conference was convened at the University of Wisconsin to discuss the plight of the Peregrine Falcon (*Falco peregrinus*) and other raptorial birds. The proceedings of this meeting (Hickey 1969) are a landmark in the study of raptor populations and ecology. Indeed, the conference served to spark a continuing interest in the study of avian predators. The Raptor Research Foundation, an important compiler and instigator of research on birds of prey, was also formed during the Peregrine Conference.

Although contamination by pesticides (Cade et al. 1971) and habitat destruction (Fisher et al. 1969) are the most serious threats to raptors, direct persecution by man (shooting, nest robbing, etc.) has long been identified as a negative influence on this wildlife resource. Zoos, government wildlife agencies, schools and universities, and private individuals are frequently called upon to care for injured or otherwise supposedly "helpless" birds of prey (Pendleton 1975). This paper describes the program of care and rehabilitation for raptors brought to the Oklahoma City Zoo.

There are several reasons why we are involved in raptor rehabilitation. *First*, raptors should be conserved as a useful part of our biota. As a conservation organization the Zoo should make every effort to do what it can to assist *all* wildlife, not just the specimens in captivity. And although most of the individuals we attempt to rehabilitate are not rare or endangered species, such threatened birds may well need our attention in the future. *Second*, by engaging in rehabilitation we are serving the people of Oklahoma who are genuinely concerned about wildlife. The vast majority (89 percent) of raptors donated to the Zoo are brought in by members of the public who have happened upon them by accident and are not familiar with proper care and treatment. In this regard, the Zoo is fulfilling its educational and service role. *Third*, by treating common wild birds for fractures and other illnesses, Zoo personnel gain valuable knowledge about the handling of similar injuries in rarer, exotic specimens within the collection or as brought to us for rehabilitation to the wild.

Methods

Most people call the Zoo prior to bringing a bird to us. In some cases where it is clear that a newly fledged brancher has been found, we make every effort to have the bird returned to its nest area where most often the adults will continue to feed it during the normal developmental process.

When a bird reaches the Zoo, the donor is asked to fill out an entry slip giving basic information—species, age, sex, when and where captured, and most important, the donor's signature releasing all rights to the specimen. Since migratory birds are now protected by federal law, this release would be a mere formality except that it protects the Zoo should a person return later asking for the bird or wanting to know why it is not on display. The donor is told that the Zoo will not necessarily retain the bird but will make every effort to return it to the wild and see that it is cared for humanely in the meantime.

Our policy is to examine each raptor as quickly as possible. If the prognosis for recovery and release is not good—for example, in severe, old, open fractures—we euthanize the bird immediately with an intravenous or intraperitoneal overdose of pentobarbital unless one of the following criteria is met: (1) the bird is a member of an endangered species, (2) the bird's treatment would be a useful learning experience for the Zoo, (3) there exists a specific need for the bird, such as for captive propagation, education, or exhibit purposes. In connection with the last criterion we make every effort to consult local law enforcement personnel of the U.S. Fish and Wildlife Service and Oklahoma Department of Wildlife Conservation.

The first step in treatment of a raptor is to identify it and to determine the nature of its injuries. Uninjured birds or those that are temporarily stunned can be banded with a U.S. Fish and Wildlife Service band and released immediately. Where a branching eyas, or young bird removed from the nest, is involved, the hacking procedure employed by falconers is used (Michell 1959). A hack box or artificial nest is constructed to protect the young and to form a base on which food is supplied daily. In the normal fledging process, the eyas gains flight experience and later independence from the human food source (figure 1). The problem with hacking raptors in the Zoo environment is the potential for predation on resident animals. With large hawks and owls (i.e., Red-tailed Hawk [*Buteo jamaicensis*] and Great Horned Owl [*Bubo virginianus*]), a hack location away from the Zoo and from large numbers of people is selected. We have successfully hacked the insect- and rodent-eating Mississippi Kite (*Ictinia mississippiensis*) and Barred Owl (*Strix varia*) on the Zoo grounds, however. If a bird is injured, a radiograph is made to determine the nature and extent of fractures, if any, and to determine whether gunshot is involved (figure 2). Radiography without chemical or human restraint is quite feasible if the bird is hooded (Stockinette,

Curity[®], Kendall Orthopedic Products, is suitable), and heavy objects (lead-lined x-ray gloves work well are used to pin the wings or legs out in an appropriate position (figure 3). At this time up to two milliliters of blood are taken from the brachial vein for a study at Oklahoma State University (Stillwater) on avian blood parasites (A. Kocan pers. comm.).

Injured birds with no fractures can best be placed in a darkened box (animal shipping crates work well; some have used cardboard containers) until they recover. Where fractures are involved, the affected limb should be immobilized immediately; we use Bandaging Tape (Vetrap[®], 3M Animal Care Products) with great success as it does not adhere to feathers (see Fuller in press). For many wing fractures binding is sufficient to effect healing in several weeks. The bird is kept on a good quality diet of whole animals (chicks, chicken necks, rats, and pigeons are our usual food), and remains quiet in the darkened chamber. In cases of severe malnutrition, intubation may be indicated. A blended soup of flat coke, egg yolk, and skinned whole animals (mice, chicks, quail, sparrows) is administered into the crop or stomach with a syringe and rubber catheter (Snelling 1970). For a two-kilogram bird, 15 to 20 ml of fluid should be given several times each day. Intubation can be very effective in saving birds which cannot or will not eat.

In cases of severe fracture, surgery may be indicated. We utilize Ketaset[®] (ketamine hydrochloride, Bristol Laboratories), in an initial intravenous or intramuscular dose of 33 mg/kg of body weight (see also Fuller et al. 1974); one part acepromazine (Ayerst Laboratories) per ten parts Ketaset[®] helps to reduce the convulsions associated with recovery. Standard intramedullary pinning procedures are followed (Mutchler 1972; Redig 1976 Secord 1958), the limb being bandaged with Vetrap[®] following surgery. Pin removal is usually undertaken in two to three weeks, depending on a radiographic determination of bone callous formation.

In order to facilitate successful rehabilitation, we strive to release raptors as soon as possible, a practice which minimizes loss of muscle tone. A critically important step, however, is determining whether the bird can fly well enough to survive. We have followed several different procedures, depending on the individual case.

First, a healed bird—if already experienced in hunting—may simply be banded and released. If it can fly well enough to elude recapture, it is probably well enough to survive. In one case a Red-tailed Hawk that apparently could not fly well was left in a field. Three days later it was relocated, flying perfectly.

Our birds are often transferred from small dark boxes to larger (2x2x3m) cages (figure 4) soon after they are eating properly. This second method utilizes the height of these cages which makes upward flight to a perch possible, allowing evaluation of the bird's strength.

A third approach toward flight evaluation and conditioning is to employ a high perch (called a "Presley" perch) utilized by falconers (Fritz 1974). The bird is fitted with jesses and leash (twice the length its perch is high), and is tied to a perch several meters high. When it is capable of gaining this perch easily, it is deemed releasable. Dr. John Lee (pers. comm.) in Idaho uses this method successfully.

The fourth method is to allow a falconer to exercise and condition the bird; we employed this technique with a Cooper's Hawk (*Accipiter cooperi*) which later was released.

The fifth method, and probably the most reliable one, is to loose each bird in a large flight room for several weeks prior to release; an old barn loft makes an excellent prerelease chamber; here at the Zoo we have used a metal shed 10x5x3m.

During the entire time a bird remains at the Zoo, from entry until final disposition, records are kept on standardized Zoo data forms; these include clinical diagnosis, diet, behavior, treatment, and other potentially useful information. The U.S.F.W.S. Law Enforcement office in Albuquerque, New Mexico, has requested that we keep entry and removal records, but does not require a Special Purpose Permit for rehabilitation as the Zoo is a public institution.

Carcasses of birds that die or are euthanized are sent to museums on request or are turned over to the U.S.F.W.S. for final disposition.

Results

This report covers the period October 1973-December 1974. Fifty-eight raptors (orders Falconiformes and Strigiformes) were donated during the period. Table 1 presents age, sex, and numerical data on the species we have treated; the predominant species are the Red-tailed Hawk, Great Horned Owl and Barred Owl. Of those individuals accurately identified 69.7 percent were immature, and 30.3 percent adult, with 58.3 percent female and 41.7 percent male. Private citizens donated 89.0 percent of our birds; the remaining 11.0 percent came from U.S.F.W.S. law enforcement personnel and the Oklahoma City Animal Welfare Division.

Figure 5 shows that more than half (62.0 percent) of our birds were brought in during the months between September and February—a time when hunters are afield and are most likely to encounter injured birds. It is also the period when northern migrant raptors winter in Oklahoma in large numbers.

Table 2 summarizes the state of injury of raptors donated to the Zoo. No injury could be found for 21.1 percent of the birds. Only 22.7 percent were definitely shot as determined by radiograph analysis, with more Falconiformes than Strigiformes suffering this fate. The 38.0 percent listed as unknown results from our initial reluctance to radiograph all raptors; judging from the experience of others, most of these unknown cases were also probably shot (see Discussion). Wing injuries were more frequent than all other clinical signs, comprising 52.0 percent of all cases treated. The humerus is most likely to be affected; 42.0 percent of all wing injuries involved fractured humeri.

The success of our rehabilitation effort is measured in table 3. Birds which did not survive, because of either spontaneous death or euthanasia, comprised 34.0 percent of our sample. A small number (9.4 percent) of birds were retained for specific uses, and 17.0 percent of the cases were still being treated at the end of December. Most significant for measuring success was the number of rehabilitated birds released to the wild, in our program 39.6 percent; 91.0 percent of these birds were banded.

Discussion

How do these results compare with those of other raptor rehabilitation projects? Most of the published information on raptor rehabilitation to date has come from a small sample of such projects. The University of Minnesota group (Fuller et al. 1974) treated ninety birds of seventeen species over a fourteen-month period. Gunshot accounted for injury to 51 percent of their birds, and 40 percent were released to the wild. These figures are comparable with ours. Perhaps their most noteworthy case was that of an adult Bald Eagle (*Haliaeetus leucocephalus*) treated and released, which was later found breeding in the wild (M. Fuller pers. comm.). Wisecarver and Bogue (1974) also present data with which our effort can be compared. Of 365 birds treated over a seven-year period, 81 percent came from public donation. Only 8 percent were shot, and 47 percent were released to the wild. Aside from

the surprisingly low percentage of birds shot, these figures compare very well with ours. Mutchler (1972, 1973), working with the Hawk Mountain Sanctuary Association, treated over fifty raptors in 1972. Both Mutchler (1972) and Redig (1976) present good information on intramedullary pinning and postoperative care.

Rehabilitation is being undertaken elsewhere, but no success figures are published (T. Buchanan, J. Lee, R. Thacker pers. comm., Maxwell 1972; Spivey 1973).

Several specific points merit discussion. First of all, a massive public education program on the growth and development of young birds (and mammals?) is needed to control needless removal of fledglings from the wild. Each spring we handle several dozen calls per week about "helpless" birds found by the public; the 20.8 percent of our raptors donated without injuries speaks for itself. Media coverage each spring concerning this problem can help. When speaking before school and other groups, we should not fail to mention how young birds achieve self-sufficiency.

With respect to veterinary considerations in treatment, our use of ketamine hydrochloride has proven effective, although the phase of recovery from anesthesia, wherein the birds thrash around quite violently, appears to be a potential danger. We have used Stockinette to restrain a bird during this period. Dr. Pat Redig (pers. comm.) recommends using 1.0 mg/kg diazepam (Valium^R, Roche Laboratories) in the ketamine dose to reduce the violence of recovery; acepromazine (see Methods) also helps.

We have also seen arthrosis or ankylosis in the wing joints of birds following routine pinning, or taping. P. Redig (pers. comm.) reduces these problems by unbandaging a wing as soon as possible after pinning and using passive physical therapy to exercise joints.

The post mortem finding of herpesvirus in a Great Horned Owl is significant and points to the necessity for adequate isolation of a raptor rehabilitation program from other bird collections. Herpes is a highly virulent virus and has the potential to wipe out a collection of birds (Graham et al. 1975). Another interesting finding, stemming from the cooperative blood data project, is that several of our birds have had *Leucocytozoon* spp. infections sufficient to cause death in young waterfowl (A. Kocan pers. comm.). Both these findings suggest the great potential of raptor rehabilitation projects for generating data other than that strictly on treatment and release of birds.

Future study of rehabilitation might include the technique of practice hunting prior to release. Wisecarver and Bogue (1974) refer to giving eyas or fledgling raptors experience in killing live prey prior to release, as training for successful hunting. Spivey (1973) even presents photographs of this activity. Although we have not used this technique, we can see nothing wrong with it as long as it is low key and away from misinterpretation by the public. Two independent holders of U.S.F.W.S. special "hospital" permits have described to me their practice of using live kill on all birds under their care. While this may restore human confidence in the ability of their birds to kill, we assume that any bird which has lived in the wild for several months already knows how to capture prey. Furthermore killing prey, usually rats in cages, is not the same as hunting in the wild. The Philadelphia Zoo recently lost an irreplaceable egg-laying Monkey-eating Eagle (*Pithecopaga jefferyi*), when she apparently tried to capture a live rabbit; breaking a talon, she bled to death (G. Griswold pers. comm.). Although this tragedy is unusual, it illustrates potential problems with killing in cages.

In the literature, very little mention is made of banding rehabilitated raptors prior to release. Although returns are meager in nearly all bird-banding efforts, there is no other way, short of radio telemetry, to determine what happens to birds once they are released. We have had one return to date, a Red-tailed Hawk found three weeks after release about five kilometers from the release site. Although it was found alive, it had rebroken a fractured leg. Acquisition of a federal bird-banding permit is not recommended for incidental banding, but there is usually a permit holder in the area who will be willing to band rehabilitated birds or make the rehabilitator a subpermittee; some state and federal wildlife personnel could also be of help.

Rehabilitation of birds of prey is a rewarding, worthwhile endeavor. What we need now is more communication among projects so that maximum benefit can be gained from our combined experience. The Rehabilitation Committee of the Raptor Research Foundation is in a unique position to spearhead this effort by providing a forum for all interested parties in its Information Exchange.

At the local level more zoos, universities, state game farms, and private individuals including falconers, are all involved with rehabilitation. In speaking with law enforcement personnel, to whom many injured birds are first given, we found that some are not aware of the various places where birds can be sent for care. At the very least, people in a particular area should be enough in contact so that they are taking the same kinds of data; in this way standardized regional reports may be prepared for each year's activities. Or, perhaps the various rehabilitators in an area could meet to decide who is best equipped to handle certain kinds of birds. For example, a person living far out in the country would be in the best position to hack fledgling raptors. And falconers are often best equipped to rehabilitate birds that need extensive exercise prior to release.

We should also be weighing the kind of question raised by Smith (1974) about "limiting the volume of rehabilitation on common species." Given limited resources, greater effort in saving a few threatened, rare, or endangered species may be more appropriate than effort spent on a wide variety of more common species—*after* the basics have been learned on common species.

Acknowledgements

Many people have aided in the success of this project. Drs. Wesley Johnson and Alma Lee Perotka examined birds, made radiographs, and performed surgery, often on their own time. Members of the Zoo's bird staff assisted in feeding, and a volunteer, Mr. Bryan Gardner, was helpful in all aspects of the project. The administration of the Oklahoma City Zoo, especially its Director, Mr. Lawrence Curtis, is to be commended for financing and encouraging a project separate from the normal display of animals. Drs. Bedford Vestal and Pat Redig and Messrs. Mark Fuller and Roger Thacker read and made helpful suggestions on drafts of the manuscript. Ms. Mary Wilson assumed the task of typing all drafts and the final manuscript.

Lastly, I thank the citizens of Oklahoma who through their thoughtfulness in bringing injured birds to our attention, assist greatly in the conservation of our raptor resource.

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Table 1
 Raptors Donated to the Oklahoma City Zoo
 October 1973 - December 1974

	Age			Sex			Total
	Adult	Immature	Not Identified	Male	Female	Not Identified	
Falconiformes							
Accipitridae							
<i>Ictinia mississippiensis</i>	0	5	0	0	1	4	5
<i>Circus cyaneus</i>	0	1	0	1	0	0	1
<i>Accipiter cooperi</i>	0	1	0	0	1	0	1
<i>Buteo jamaicensis</i>	6	9	0	4	6	5	15
<i>B. j. harlani</i>	1	1	0	0	0	2	2
<i>Buteo linneatus</i>	0	1	0	1	0	0	1
<i>Buteo swainsoni</i>	1	2	0	1	2	0	3
<i>Buteo lagopus</i>	1	0	0	1	0	0	1
<i>Buteo regalis</i>	0	1	0	1	0	0	1
<i>Aquila chrysaetos</i>	0	1	0	0	0	1	1
<i>Haliaeetus leucocephalus</i>	1	0	0	0	1	0	1
Falconidae							
<i>Falco sparverius</i>	0	0	3	1	2	0	3
Total	10	22	3	10	13	12	35
Percent	28.6	62.9	8.6	28.6	37.1	34.3	
Strigiformes							
Tytonidae							
<i>Tyto alba</i>	0	0	2	0	0	2	2
Strigidae							
<i>Asio otus</i>	0	0	1	0	0	1	1
<i>Strix varia</i>	0	0	5	0	1	4	5
<i>Otus asio</i>	0	0	2	0	0	2	2
<i>Bubo virginianus</i>	0	1	6	0	0	7	7
<i>Speotyto cunicularia</i>	0	0	1	0	0	1	1
Total	0	1	17	0	1	17	18
Percent	0	5.6	94.4	0	5.6	94.4	
Grand Total	10	23	20	10	14	29	53
Percent	18.9	43.4	37.7	18.9	26.4	54.7	

Table 2
Types of Injury to Raptors Donated to the Oklahoma City Zoo
October 1973 - December 1974

	INJURED											NOT INJURED									
	Shot					Not Shot					Unknown ⁵					Falconer's Escape	Nestling				
	Head	Back	Leg	Wing		Head	Back	Leg	Wing		Head	Back	Leg	Wing							
				H ¹	O ²				H	O				Singed	H			O	Stunned		
Falconiformes	2	3	6			1	1	1	1	1						2	5	4	2	1	6
	28.6% ⁴					14.3%															20.0%
Strigiformes																					

¹ humerus ² other ³ one hit by automobile ⁴ all percentages adjusted for multiple injuries ⁵ not radiographed

Table 3
Disposition of Raptors Donated to the Oklahoma City Zoo
October 1973 - December 1974

	Did not survive					Retained			Released			Pending	
	Euthanized	Died	M ¹	R ²	Carcass F ³	U ⁴	State	OKC Zoo	Other Zoo	Research	Hack	Simple Release	Recovery
Falconiformes	6	6	7	2	2	1	1	2		1	7	6	6
			34.3%					8.6%			40.0%		17.1%
Strigiformes	1	S ⁵		1	2	3		1	1		4	3	3
			33.3%					11.1%			38.9%		16.7%
Total	7	11	7	3	4	4	1	3	1	1	11	9	9
			34.0%					9.4%			39.6%		17.0%
¹ museum specimen		² research		³ frozen		⁴ unknown							⁵ one with herpesvirus diagnosed from liver

¹ museum specimen² research³ frozen⁴ unknown⁵ one with herpesvirus diagnosed from liver



Figure 1. A hack box for American Kestrels (*Falco sparverius*) can be made from a cardboard box. This one was placed in the rafters of a shed.



Figure 2. Typical radiograph of a Red-tailed Hawk shows the presence of lead shot and the resultant skeletal damage. Six pellets caused fracture of the left tarso-metatarsus, and extensive destruction of the right radius and ulna.



Figure 3. Immobilization of an adult Red-tailed Hawk for radiography. By taking advantage of the immobility response, one can get wild birds to remain still on their backs long enough to make the exposure. A crude hood is used, and a weighted glove keeps the wing extended. Of course, care must be taken when releasing and grasping the legs.



Figure 4. Wire cage, with inner plywood and burlap lining, used to house raptors during recuperation. The two-meter height of these enclosures affords some exercise when a bird jumps to perch near the top.

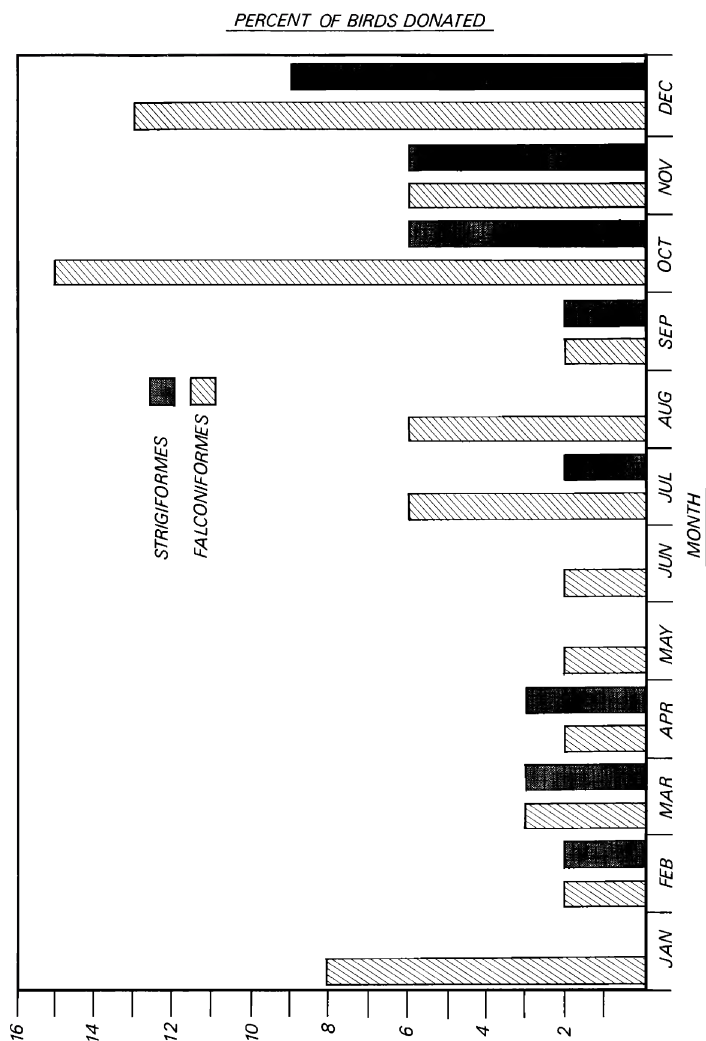


Figure 5. Histogram showing the percent of raptors donated to the Oklahoma City Zoo each month January — December 1974.

SURVIVAL RATE OF WILD ADULT PRAIRIE FALCONS DEDUCED FROM BAND RECOVERY DATA

by
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Introduction

The Prairie Falcon (*Falco mexicanus*) has been banded in the western United States and Canada at least since 1928. There are 184 recoveries of Prairie Falcons listed in the Bird Banding Laboratory's computer printout dated 23 October 1973. It is possible to estimate from these recoveries the survival rate of breeding-age Prairie Falcons in the wild, using the same methods used to extract a similar estimate for Peregrines (*Falco peregrinus*) from a sample of similar size (Shor 1970). Although the two species are similar in proportion and appearance, and to some extent in habit, the Prairie Falcon has a somewhat shorter life expectancy as an adult than the Peregrine if values deduced from band recovery data are to be believed.

Assumptions and Methods Used

The methods used in this paper have been described in some detail elsewhere (Shor 1970), but they will be repeated here in abbreviated form. The study is based on a number of assumptions. First, the number of recoveries is assumed to be proportional to the number remaining alive of a given cohort of adult birds. It is not possible to extend this assumption to include immature birds, because for most species their death rate is known to be considerably higher than that of adults. Recovery data indicate that the higher rate exists among immature Prairie Falcons as well. However, the assumption is probably roughly correct for adults, with which this study deals. A second assumption is that the recovery rate is higher during the first few months after banding than might be attributable to normal mortality rates. The higher rate is assumed to result from the fact that some of the raptors trapped and banded are caught because they are sick, weak, or injured and are therefore recovered at a higher rate than is representative of the population as a whole. Accordingly, no recoveries made less than a year after banding are considered. A third assumption is that most Prairie Falcons do not breed until their third year; so birds banded as nestlings or in their hatching year are not included in the sample until at least two years have passed. These precautions assure that only birds of breeding age are considered. Fourthly, in order to avoid another kind of bias, recoveries made by banders themselves are in most cases eliminated from the sample. Most Prairie Falcon recoveries by banders appear to have been made at or near a nest site, and it is not certain that banders working in an area will continue to do so over long periods. Therefore, such recoveries could tend to bias the results in the direction of a shorter-than-actual life span. Recoveries by banders not working at nest sites appear to be of the order of random captures and are therefore included if they can be so identified. Finally, the maximum life span of a Prairie Falcon is much longer than this sample indicates is normally achieved in the wild; the birds must very rarely die of old age. Therefore the mortality rate of adults is assumed to be constant, not changing with age.

All recoveries of birds banded in the nest or during their hatching year which are made at least two but less than three years after banding are included in the "base year" of the analysis. Similarly, all recoveries of birds banded after their hatching year which are made at least one but less than two years after banding are also included in the "base year." Later recoveries are included in the first, second, and later years after the base year, as appropriate. Once the totals in the base year and each succeeding year are determined, the life expectancy is found by fitting an exponentially decreasing function to the numbers recovered in the base year and each year thereafter through a maximum likelihood method. This function is corrected for the fact that the period of observation is of finite length and that long-lived birds can therefore be recovered only from the cohorts banded early in the interval.

The Data Base

There are 184 recoveries included in the data, of which 103 are of birds banded in 1955 and later. Banding data are available only on birds banded in 1955 and later, whereas recovery records are available back to birds banded in 1928. Corresponding to the 103 recoveries of birds banded from 1955 through 1972 are a total of 2717 birds banded. A few recoveries in 1973 are included, but they are all of birds banded in 1972 and earlier. Therefore dividing the 103 recoveries by the 2717 birds banded provides a rough approximation of the recovery rate—about 3.8 percent. A few more birds will be recovered from this group (551 were banded in 1972 alone), so that ultimately the recovery rate will go somewhat above 4 percent. A rough extrapolation indicates that it will reach about 4.3 percent if earlier recovery rates continue.

The band recovery rate for most other raptors was higher in the 1930s and 1940s than it is today, so that it can be expected that the recovery rate between 1928 and 1954 must have been higher than the one computed above for the interval 1955-73. Hence it can be expected that the number of birds banded to produce 81 recorded recoveries in the earlier interval was smaller than would have been required to produce 103 recoveries in the later period. Assuming a recovery rate of 4.3 percent, we get $81/.043 = 1884$ birds banded to produce 81 recoveries. There must actually have been fewer, so the total number of birds banded to produce the 184 recoveries discussed in this paper must have been less than $2717 + 1884 = 4601$.

Results

If the recoveries are sorted into those of birds banded as nestlings or hatching-year immatures and those banded later (listed as adults in Tables 1 and 2), a different pattern appears for the two classes. Here the first year after banding is the period from the day of banding to the day before the first anniversary of the banding; the second year is that starting the first anniversary of the banding; and so forth. There are few if any immatures in the recovery list that were banded after the end of the hatching year, so inclusion of such recoveries in the "adult" category does not bias the results significantly.

More than half the recoveries (56 percent) are of immature birds in their first year of life. A great proportion of them are recoveries by shooting. In fact 99 out of 129 recoveries of birds banded as nestlings are within a year of the time of banding. However, it does not follow that this number represents a death rate in the first year proportional to the recovery rate (i.e., $99/129$ or 77 percent). A conclusion of the study of Peregrine Falcon survival rates

(Shor 1970) was that immature Peregrines were much more likely to be recovered, in proportion to their death rate, than were adults. The same thing is likely to be true of immature Prairie Falcons. Hence the first-year death rate of birds banded in the nest may be considerably less than 77 percent. This possibility requires separate investigation.

Table 1
Prairie Falcon Recoveries by Others than Banders at Nest Sites,
Sorted by Age When Banded

Year after Banding	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Banded as Nestlings or Immatures	99	13	6	4	3	1	2	0	0	0	0	0	0	1	0
Banded as Adults	11	4	1	2	0	0	0	0	0	0	0	0	0	0	0
Banded at Unknown Age	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 2
Prairie Falcon Recoveries by Banders (Returns plus Foreign Retraps)
Sorted by Age When Banded

Year after Banding	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Banded as Nestlings or Immatures	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0
Banded as Adults	2	3	3	1	1	0	0	0	0	0	0	0	0	0	0
Banded at Unknown Age	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

When we take all the data and rearrange them as in the study of Peregrine Falcons (conservatively treating the birds banded at unknown age as immatures and so eliminating their recoveries in the first two years after banding), we obtain the information shown in table 3. Data on Peregrine Falcons (Shor 1970) is added for comparison.

Table 3
Prairie Falcon and Peregrine Recoveries of Breeding-Age Adults
in Base Year and After

Year of Encounter, Related to Base Year	Base Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Prairie Falcons Encountered (total)	16	9	7	2	3	0	0	0	0	0	0	1	0	0
Prairie Falcons Encountered (omitting returns and foreign retraps)	11	5	5	1	3	0	0	0	0	0	0	1	0	0
Peregrines Recovered	10	8	7	6	3	5	1	0	0	0	1	1	0	0

It can be concluded from an inspection of table 3 that the life expectancy of an adult Prairie Falcon in the wild is probably less than that of an adult Peregrine. However, this conclusion must be confirmed by comparison of calculated values for life expectancy including allowance for the finite length of the observation interval, since many of the Prairie Falcons banded were nestlings banded toward the end of the period covered by the data. In addition, to make the results comparable with those for Peregrines, the assumption is made that serious loss of bands does not start until the beginning of the fourteenth year after banding ($x=11$) and is complete by the start of the eighteenth year after banding.

Table 4
Values of the Parameter c_x

x	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c_x	1	.91	.85	.77	.74	.71	.69	.67	.65	.63	.60	.50	.35	.21	.07	0

Table 4 gives the correction parameter c_x which accounts for both the finite length of the period during which recoveries are possible and for the fact that bands will probably be lost. The correction is incorporated in the equation which we assume for the recovery rate for breeding-age Prairie Falcons:

$$L_x = c_x L_0 e^{-rx} \quad , \quad \dots (1)$$

where L_x is the number of birds recovered in the year starting x years after the beginning of the base year, L_0 is the number recovered in the base year, and r is the reciprocal of the life

expectancy, taken to be a constant for adults of all ages. This last assumption is justified by the fact that essentially none of the birds live long enough to die of old age, and so the causes of mortality affect all breeding-age birds in the sample in about the same way.

When a curve of the form of equation (1) is fitted to the recoveries of the second row of table 2 (recoveries of Prairie Falcons omitting returns and foreign retraps) by using a maximum likelihood method, the best fit is achieved with $L_0 = 10.2$ and $r = 0.422$. The reciprocal of 0.422 is a point estimate of the life expectancy of an adult Prairie Falcon in the wild—about 2.4 years—considerably less than the four-year life expectancy computed in the same manner for the breeding-age Peregrine (Shor 1970). It confirms the impression obtained by comparison of the recovery data for the two species in table 3.

It is difficult computationally to obtain an estimate of the statistical confidence of this point estimate directly from the maximum likelihood computation. However, a feel for the value can be obtained by finding the effect of statistical fluctuations in the number of birds recovered each year on the value of r computed by making a least squares fit to the data. Through this approximate scheme, 95 percent confidence limits of about 2.0 and 2.8 are derived for the life expectancy of a Prairie Falcon. Both these values are much less than the four years derived for the Peregrine, so it can reasonably be concluded that the life expectancy of an adult Prairie Falcon in the wild is considerably less than that of the Peregrine.

Acknowledgment

The author is indebted to Mr. Richard Fyfe of the Canadian Wildlife Service for permission to use in this statistical analysis the data on recoveries of Prairie Falcons that he has banded. Fyfe has banded more Prairie Falcons in recent years than any other bander.

Reference Cited

- Shor, W. 1970. Peregrine Falcon population dynamics deduced from band recovery data. *Raptor Res. News* 4(2):49-59.

PRELIMINARY NOTICE — 1976 MEETING OF THE RAPTOR RESEARCH FOUNDATION

As approved by the Board of Directors at the annual meeting in Boise last November, the 1976 meetings will be held at Ithaca, New York, home of Cornell University, with Dr. Tom Cade serving as local chairman. Cosponsoring organizations include the Laboratory of Ornithology and the Peregrine Fund. The meetings will commence on Friday, October 29, and run through Monday, November 1. The Ramada Inn in Ithaca will serve as conference headquarters, with some activities planned for the Laboratory of Ornithology at Sapsucker Woods. A call for papers and other details will be forthcoming in future announcements.

HAWKING FISH WITH "NEPTUNE" – EXPERIENCES WITH AN OSPREY

by

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Translated by

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Translator's Note: This lively account reflects post-World War II attitudes towards Ospreys (*Pandion haliaetus*) in West Germany. It contains biological information and, most important, it should help those rehabilitation centers that deal with Ospreys. This paper was originally published in *Wild und Hund* 70(23):559-560, 1968.

In the thirties, shortly before my graduation, my grandfather was an official in the Forest Service in Thuringen. We had a number of fish ponds stocked with carp. Ospreys were both resident and breeding nearby. I read in an old book once that this species had been trained for fishing, but nowhere could I find out *how* to do it.

By chance I watched an Osprey fishing. He misjudged his capabilities and, together with the fish, lodged in a large weir from which neither could extricate itself. I hurried over with my net and rescued them from their prison. The fish was already dead, and the Osprey struggled to get out of the net, but could not. I let him thrash about and brought him home and put him in an empty goat shed so that he would quiet down. He flew to the edge of a feed trough, where he sat anxiously.

In order to tame him, or, as falconers say, to "man" him, I used the techniques well described by the old master falconer, R. Waller, for the training of Goshawks and wild-caught falcons, except it was a live *fish*, just caught in the pond, that I held out to him every day. I let him take a full crop. The first day he danced about on a pole, eyed the flopping fish, but did not dare to come nearer. I stood as still as an oil painting. I spoke softly to soothe him, but he did not take the fish, although I stood by him for a half an hour. I did the same the next day. He must have been hungry because he snatched the fish from my hand and retreated along the pole to eat it a little away from me.

In the meantime, I had built a mews with the help of my grandfather, who, however, laughed at me pityingly when I explained what I planned to accomplish with the Osprey. He let me carry on, figuring that I would have to find out for myself. Grandpa felt I should put a hood on the Osprey. I refused, saying that Ospreys do not wear hoods in the wild. Besides Goshawks and Golden Eagles trained for falconry are not hooded. My reasoning was that as Ospreys specialize solely in catching fish, they would not be diverted or made uneasy by other types of quarry while being carried around in the area. I was right. "Neptune," as I had named him, maintained the bearing of a noble eagle, an eagle who could be disturbed by nothing—nothing but fish.

So it was that Neptune was not hooded. With good food and tender care, the Osprey grew handsome. I weighed him daily; his weight remained between 1.5 and 1.8 kg. This weight and plumage in first-rate condition are essential for successful hunting. (Let it be noted that the "he" was a "she.")

Next I put jesses on Neptune and tethered her to a bow perch by day on the meadow in front of the shed. The jesses need to be adapted to the particular hunting method of this species. As it always goes into the water feet first, foreign bodies on the tarsi are a detriment. Also one does not have to put bells on an Osprey, as they fill up with water and become useless.

After many attempts to devise jesses that one could release with a single pull, I gave up. In the meantime, Neptune had become so well manned that she remained on the fist without jesses and showed no inclination to regain her freedom. When she was supposed to fly, she flew free from tree to tree—toward the pond—and waited there for me. I had problems training her to the lure. The kind of lures our grandfathers used for Goshawks and falcons did not interest her at all. She plucked off bits of fish fastened to a lure, and that was the end of a kill for her. Finally I got her to understand that she must let her human hunting companion take her *quarry* away from her, but she was allowed to feed to her heart's content on the *lure*. After much pondering I made her a lure using a two-year-old stuffed carp. It left her cold. When I tied bits of fish onto the stuffed carp, she plucked them off and left the lure; sometimes she was off to a tree, and sometimes she came to the fist.

It was clear, and it took me some time to recognize it, that the Osprey had no interest in, and could not react to, anything that crawled on the ground or flew in the air. Her quarry was in the water. As one would release bagged pigeons to Goshawks or falcons, I placed many two-year-old carp in a cask arranged so that I could shove them out and plop them into the pond. After a few practice runs I got the quirks out of this system, and the fish played the game with evident pleasure.

By now I was serious. The cask was set upright in the pond with a release hole just above water level. By means of a rope and pulley attached to a pusher, the fish were shoved out. I stood about ten meters away with Neptune on my fist. I gave my cousin Herbert, who was helping me, the signal. The pusher moved, and with a rush of water the first carp shot out and splashed into the pond. Neptune became alert on my fist and viewed the cask with interest. Soon the second carp shot out. Neptune began to dance, and as the third carp came out of its prison into the pond, the Osprey left the fist, made a short maneuver, and plunged feet first into the water, sending up a good spray above both herself and the fish. After about two seconds she emerged again carrying the fish, already dead as a result of her dagger-sharp talons.

Book-learning had convinced me that the Osprey consumes its quarry on the ground, so I waited for her to carry it somewhere so that I could take it away from her. She failed to oblige me by doing anything of the sort. Instead she circled me a couple of times, called, and then landed on my right shoulder with her prey. This style was dead wrong. I extended my arm, and she stepped onto my fist. Now the "fish lure" played its part. My cousin displayed it to her and simultaneously covered the fish she had just caught. Neptune shook her head, but stepped up onto the lure after all and took the tiny pieces of fish flesh from it while Herbert took the fish from her and let it disappear in the creel.

This first success was simultaneously the first failure: success because Neptune had finally taken quarry, failure because she had retrieved. Birds flown in falconry are not supposed to retrieve. How could I keep her from doing anything so unorthodox? I wished to be correct and to take her quarry from her. I reasoned that Ospreys sometimes eat their quarry on the ground but sometimes carry it to a tree to feast. Suitable perch trees were scarce along the shore; I had become a substitute tree. I recalled that we had once erected a perch tree for an Eagle Owl decoy when we were shooting crows from a blind. I procured an old stub about my size and erected it on the shore.

The following day we tried the “bagged” fish again. Neptune circled me a couple of times with a fish again and then flew to the tree and perched. I rushed over to her and got her quarry away from her as on the previous day.

A few days later—a warm summer day when fish are wont to jump—we went again to the ponds, this time without the cask and “bagged” fish. I wandered along the shore with her. She was scot-free on my fist. Neptune viewed the unrippled water with interest. Suddenly she shifted and began to dance in the typical manner. She shot off, and feet first she plunged into the water. The surface of the water was disturbed for a short time, and then the Osprey emerged with a fish that she had caught in the wild. She gave what seemed to be a triumphant call and perched on “her” tree. I took the fish from her there and let her come to my fist.

Many hunting days followed—rich in experience with Osprey and fish. I can now summarize my observations and experiences as follows:

The Osprey cannot be trained like a falcon or Goshawk. Its quarry is simply fish, and it does not distinguish between species, taking carp, tench (*Tinca vulgaris*), pike, and pike-perch.

A wild-caught Goshawk, on the other hand, does distinguish between quarry species. If it has been entered on (taught to pursue) rabbits, the bird must be reconditioned if one wishes it to take pheasants. The Osprey is carried unhooded as it is not disturbed by flushing quarry, people, or vehicles. One can equip it with normal jesses when carrying it about in the area. If it becomes particularly tame, one does not need jesses as it rides free on the fist or on a perch fastened onto the baggage carrier of a bicycle.

The Osprey does not always take its quarry to the ground to feed upon it; it prefers a tree near the shore. If no such tree is near, it accepts its human hunting companion as a “tree” and perches on his hat or on his shoulder. Therefore the falconer erects an artificial tree near the shore—about the size of a person—and takes the quarry from the Osprey without difficulty. It is best to train the bird by releasing fish for it to catch. The fish are released from a cask into the water of the pond. All other methods of entering Ospreys with lures garnished with feathers or fur are futile as they have no interest in birds or mammals as quarry. A stuffed fish or a fish lure is recommended to get the bird to step onto the fist. After it is well trained, one can take its quarry away without using a fish lure. One covers the fish with one’s gloved hand and pulls it away with the left hand.

The trained Osprey is kept in a mews on a high screen perch just like a Goshawk or falcon. A bow perch and a bath pan should be placed near the mews in the shade. The Osprey likes to bathe more frequently than any other raptor.

It is ecologically interesting that the Osprey is the only (diurnal) raptor that can reverse its outside toe to grasp. It always carries its prey headfirst and never crosswise. In captivity it must be fed fresh fish; these are handed to it whole so that the Osprey can pull them apart itself. It will disgorge the undigestible parts, such as scales and bones, in pellets.

For the most part the Osprey is flown from the fist and returns to the fist with its prey. In other words it “retrieves.” This comes from its habit of consuming food on a high perch where it is safe from herons that often try to chase it away from its prey in the wild. Now and again the Osprey waits on high over the pond and plunges into the water from the air; it always dives feet first.

An Osprey may misjudge the strength of its quarry. Then the falconer must go into the water with his big net and bring back both Osprey and fish if he does not wish to lose his bird. The Osprey cannot remain under water long, or it will drown.

Experiences with nestlings or branchers are not available. It would be harder to train them for hunting. One just cannot follow an Osprey over its fishing territory; instead it must return to the falconer after a successful hunt. This fundamental difference between hawking fish and hawking game justifies carrying. (It is bad form for a falconer to let his bird carry prey.)

The war interrupted my experiments with the Osprey, and after the war I could not resume them again.

One should explain to the owner of a pond and to fishermen that the damage incurred to fish is slight, when only one bird is involved. The situation would be different in the case of a breeding pair, but Ospreys are not known to breed in West Germany. Besides, Ospreys did not invent the tin can—men did. Men hunt to store food and to hoard; Ospreys hunt only for survival. Many a day their crops are empty. Those who view nature only from the standpoint of usefulness and materialism will never grasp the greatness and beauty of creation. They will consider my experiences, and the trouble I took with an Osprey, useless and senseless as they did not result in “production”!

The observations and experiences with the Osprey are experiences in the beauty of nature. Its splendid fishing flights and its steep plunges, with water splashing high, enrich knowledge of nature and teach us to mind the ecological and biological balance and to restore natural conditions where thoughtless and selfish people have damaged them.

The Osprey belongs to the natural landscape as do the fish, the Goshawk, the rabbit, and the fox. Man needs to regulate, where it is advantageous, with consideration of biological forces and with respect for creation, or he will become *primus inter pares* and nothing more.

HAWK MIGRATION ASSOCIATION

The Hawk Migration Association of North America will hold its 1976 Conference at the University of Minnesota, Duluth Campus. The campus is within a ten-minute drive of Hawk Ridge, one of the great hawk migration lookouts. Dates of the conference will be September 2-5. Further details may be obtained from Dr. P.B. Hofslund, Biology Dept. UMD, Duluth, MN 55812.

MALE BLACK SOLITARY EAGLE NEEDED

The Fort Worth Zoo is searching for a male Black Solitary Eagle (*Harpyhaliaetus solitarius*) to be paired with its female Solitary Eagle that nests and lays each spring. If any member of the RRF knows of any Solitary Eagle anywhere in the United States, please contact Ronald Kimble, Supervisor of Birds, Fort Worth Zoo, 2727 Zoological Park Drive, Fort Worth, Texas 76110.

OWL MORTALITY ON FENCES AND UTILITY LINES

by

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ABSTRACT. McCarthy (Wilson Bull. 85:477-478) and Edeburn (Wilson Bull. 85:478) discuss unusual deaths of Great Horned Owls due to collisions with barbed-wire fences. This report describes the wire-caused deaths of three Short-eared Owls (*Asio flammeus*) and one Great Horned Owl (*Bubo virginianus*) in southeastern Washington and adjacent Idaho during the winter of 1973-74.

Observations of Owl Mortality

On 30 December 1973 a Short-eared Owl was found dead, hanging by its right wing from the top strand of a 4-barb barbed-wire fence, 3½ miles southwest of Pullman, Washington. A wire barb had pierced the skin and muscle halfway between the ends of the radius and ulna, both of which were fractured.

On 10 January 1974 a dead Short-eared Owl was seen hanging by its left wing from a powerline at the southern city limit boundary of Moscow, Idaho. It was approximately twenty feet above the ground, making difficult the determination of the exact means of entanglement.

On 1 February 1974 three miles southwest of Pullman, Washington, a dead Great Horned Owl was found entangled in the top wire of a two-barb barbed-wire fence (Fig. 1). The bird was carefully untangled to obtain some clue as to how the accident occurred. A single barb had pierced the skin and muscle within one inch of the distal end of the radius and ulna. The momentum of flying apparently flipped the bird over the top strand, further entangling the wing on both barbs. No bones were broken.

On 2 February 1974 a dead Short-eared Owl was found hanging by its neck from a powerline 200 yards east of the Pullman airport (Fig. 2). The wire was over forty feet above the ground. Photographs revealed the wire to be of a twisted multi-strand type with no protective outer coating. Its coarse texture apparently caught the fine soft feathers of the bird's neck. I suspect that the bird flew into the line at a very slow speed; the momentum of rapid flight would certainly have pulled loose any entangled feathers.

On 28 December 1973 a live Short-eared Owl was found entangled by its neck in a four-foot-diameter, four-foot-high roll of two-by-four-inch woven fencing wire. The wire and a variety of old, rusty farm machinery were located on the edge of a large plowed field 3½ miles southwest of Pullman. The bird apparently had tried to capture a small rodent living within the confines of the wire. In its pursuit, it managed to wedge its neck between two strands of wire and was unable to escape. The owl was in an extreme state of exhaustion but recovered within 24 hours after rescue.

The discovery of three deaths and one near-death of Short-eared Owls reflects their abundance during the winter of 1973-74 in the farmlands about Pullman, Washington, and Moscow, Idaho.

Discussion

The Great Horned and Short-eared Owls found impaled on barbed wire fences are interesting cases. These birds were hunting in bare plowed fields. The only habitat available to their prey (small rodents) was narrow weedy corridors along fence rows or areas too steep or too rocky for cultivation. In such situations the owls were constantly confronted with barbed-wire fences. If they had no prior experience with such fences (i.e., birds of the year or ones raised in areas lacking fences), they might simply have perceived the fences as movable vegetation which would have caused insignificant disruption to their flight.

The owls that collided with powerlines must have done so under different circumstances. The powerlines were higher in the air, and a hunting owl would probably have been flying closer to the ground, thus avoiding them. The owls may have been flying to a hunting post, possibly the powerline itself or its supporting pole, and somehow collided with the line. They possibly were forced into the line by a gust of wind. I have viewed several Short-eared Owls being blown off course by the strong gusts of wind characteristic of winter weather in the study area.

Collisions like these will probably continue to occur in the farmlands near Pullman and in other areas of the country where fences traverse the hunting habitats of owls. The problem may be compounded where owls are particularly abundant. Owls with nomadic tendencies, like the Short-eared Owl, probably suffer the greatest losses from collisions, since they lack familiarity with their surroundings. Age may also be a factor in that young birds with relatively little hunting experience may be more subject to such collisions. Age was impossible to determine in any of the birds reported in this study.

The frequency of wire-collisions by owls remains an open question. However, it may be worthwhile to identify trouble spots where one or more mishaps have occurred and to work out some plan to reduce or eliminate future accidents. For example, old, unused barbed-wire fences could be removed. Fences in use could be marked with strips of ribbon or foil to increase their visibility.



Fig. 1. Great Horned Owl impaled on a two-barb barbed-wire fence



Fig. 2. Short-eared Owl hanging from a power line

REARING AND RELEASE OF TWO YOUNG AMERICAN KESTRELS (*FALCO SPARVERIUS*)

by

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On 5 July 1973, while banding young American Kestrels on the Buena Vista Marsh in central Wisconsin, we inspected a nest reported to us by a local farmer. It was located in a living white pine (*Pinus strobus*), part of a small clump of trees in an open field. There were several holes along the trunk; one of the uppermost, about 35 feet up, contained five young American Kestrels. All were females infested with ectoparasites. The nest material, presumably from a previous occupant, was very moist. The cavity was so narrow that the young birds were forced to sit on top of each other.

Two of the young were considerably smaller than the others and very weak. We banded, weighed, and measured the three healthy chicks and returned them to the nest but took the two weak chicks home to hand rear. Their age was approximately five days.

For the first few days we kept them in a cloth-lined cardboard box and fed them pea-sized pieces of meat, usually mice, moistened in saliva in the palm of our hands. Soon we fed them larger pieces, including fur and bone. On 8 July we found a pellet in the box.

After spending a few days in the box, the Kestrels were moved to a homemade bird feeder in the front yard of our home in the country. This afforded them sunlight and allowed them to become accustomed to their surroundings. On 18 and 19 July they flew to nearby spruce trees where they perched most of the day. At that time we offered them food at the feeder more frequently than usual, trying to lure them back. One waited an entire day before returning to the feeder. They begged for food, but were reluctant to fly. It was important that they learn to come to us for food instead of having us take food to them, for they might have flown into the nearby woods and we would never have found them. Because we consistently whistled while offering food to them, they learned to associate food with the whistle as well as with the feeder.

Once they began flying, the Kestrels spent increasingly more time away from the bird feeder and became progressively wilder. On 3 August the young birds came in the company of an adult male Kestrel that circled and screamed over our heads while we fed the young. This scene was repeated later the same day. Only one of the young Kestrels appeared on 4 August. On 5 August we did not see them. They returned for the last time on 6 August with an adult male. Within the next ten days we saw them perched nearby on powerlines with other Kestrels. They flushed with the wild Kestrels upon our approach. Apparently, though hand reared, they successfully joined the wild population.

At the time the birds began flying, they both lost weight rapidly, never returning to their preflight weights (Fig. 1), as is common in many species of nidicolous birds (Welty 1962). A similar weight pattern has been reported by Hamerstrom (1972), Holland (1923), and Sumner (1929) for wild Kestrels. These weight curves also indicate that weight is not a good criterion for determining the age of young Kestrels. Even before flying, the weights of the hand-reared birds fluctuated markedly. On 29 July we caught a wild female sibling approximately one quarter mile away from the nest tree. It weighed 114 grams. The hand-reared Kestrels were at least as heavy on that date (Fig. 1).

Acknowledgments

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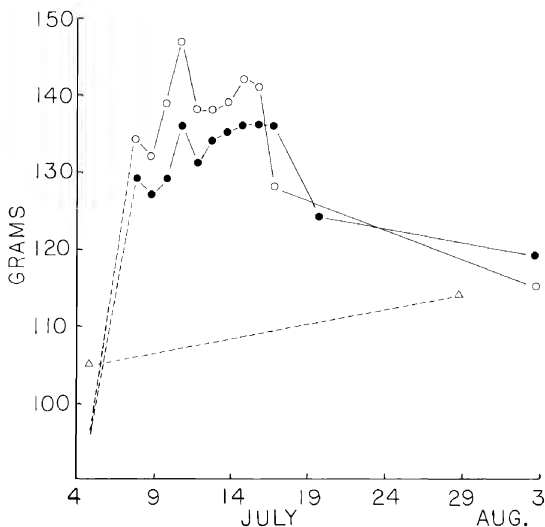


Figure 1. Weights of three young female Kestrels in relation to date. Open and closed circles represent the hand-reared birds; triangles represent weights of a wild sibling.

DISTRIBUTION AND NUMBERS OF SNOWY OWLS ON MELVILLE, EGLINTON, AND BYAM MARTIN ISLANDS, NORTHWEST TERRITORIES, CANADA

by

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ABSTRACT. During aerial surveys of Melville, Eglinton, and Bryam Martin Islands, Queen Elizabeth Group, in 1972, 1973, and 1974, numbers of Snowy Owls (*Nyctea scandiaca*) were recorded. Both high and low numbers were observed and were not found to be in phase in the different areas surveyed. The lack of phasing is attributed to regional asynchrony in lemming (*Dicrostonyx groenlandicus*) cycles caused in turn by differences in snow cover and duration of springtime snow melt.

Introduction

There are few references to Snowy Owls on the western islands of the Queen Elizabeth Islands of Arctic Canada (MacDonald 1954, Tener 1963, Taylor 1974a, 1974b). As the birds are relatively easily seen from the air, they were counted during our aerial surveys of Peary caribou (*Rangifer tarandus pearyi*) and musk oxen (*Ovibos moschatus*) on Melville, Eglinton, and Byam Martin Islands in 1972, 1973, and 1974.

The results from the 1972 survey (Miller and Russell 1973) demonstrated marked variations in owl density on different parts of Melville. In this paper, data from 1972, 1973, and 1974 are used to show differences in phasing of population fluctuations on different parts of the survey area.

Methods

In 1972 Melville, Eglinton, and Byam Martin were surveyed by Bell 206 helicopter between 7 and 24 August. In 1973 (5 July to 8 August) and 1974 (25 July to 21 August) they were surveyed by Helio-Courier fixed-wing aircraft.

Transect intervals on Melville were 6.4 km (4 mi) for all three surveys. On Byam Martin they were 6.4 km (4 mi) in 1972 and 1973, and 3.2 km (2 mi) in 1974. On Eglinton they were 6.4 km (4 mi) in 1972, and 3.2 km (2 mi) in 1973 and 1974. A strip 0.8 km (0.5 mi) wide was searched by an observer on each side of the aircraft. The surveys were flown about 150 m (500 ft) above ground level, except where the broken terrain of western Melville forced the flights to be about 300m (1,000 ft) above ground level. The surveys were flown at speeds averaging about 160 km/hour (100 mi/hour).

Eglinton and Byam Martin were small enough to be surveyed without stratification. Melville, however, was divided into 13 strata based on navigational and physiogeographical considerations. The 13 strata were regrouped as 9 for the reporting of observations of Snowy Owls by subjectively combining land areas of apparent ecological similarity (Fig. 1).

Results and Discussion

The observed and estimated numbers of owls by island and survey period are given in table 1. Owl densities and numbers are related to strata in figure 1.

Interpretations and extrapolations from the aerial surveys are subject to error inherent in the technique. For example, differences were observed in the reactions of the owls to the types of aircraft used. In 1972 owls seemed to be flushed readily by the helicopter and were thus easily seen. In 1973, when a fixed-wing aircraft was used, many owls were not flushed, and probably some that remained on the ground were missed. In 1974, when again a fixed-wing aircraft was used, we recorded whether or not the owls flushed. Of the owls seen on Melville 49 percent did not flush, whereas 33 percent of those owls seen on Eglinton did not flush. That difference suggests that more perching owls were missed on Eglinton where patches of snow occurred on the high ground. In both 1972 and 1974 some strata were not surveyed (table 1) because of weather and mechanical delays. The low numbers of owls on some small areas could produce imprecise estimates due to chance, such as on Byam Martin and Canrobert Hills in 1973 and Stevens Head in 1974. In other areas near to each other, however, the high numbers suggest that the between-year and between-area differences were real.

According to our data, owl numbers on Eglinton, Byam Martin, Sabine Peninsula, East Central, and Central Melville peaked in 1973, but on the Dundas Peninsula they decreased each year from 1972 through 1974. Changes on the Canrobert Hills from 1973 to 1974 were in phase with the changes on the five synchronous areas mentioned above. However, on Sandy Point, Stevens Head, and Cape Russell owl numbers increased from 1973 to 1974.

The highest density (10.28 owls/100 km²) and number (143 owls) on any stratum were estimated on Sandy Point in 1974. The second highest density (7.18 owls/100 km²) and number (111 owls) were estimated in the previous year (1973) on Eglinton Island about 50 km away.

Aerial and ground observations suggest that few owls nested in 1972; more nested in 1973; and none were seen on nests in 1974. Taylor (1974b) observed that average clutch size of owls on Bathurst Island in 1969 was 5.8, yet an average of only 1.1 owlets per nesting pair were successfully raised. Therefore it is unlikely that offspring returning to the Queen Elizabeth Islands could account for the overall increase in number of owls between 1972 and 1973 or the increases on some strata between 1973 and 1974. Adult owls must shift their summer ranges from year to year.

Most of the owls were seen as individuals, but a group of three was seen on Dundas Peninsula in 1972, and a group of four on Eglinton in 1974. In areas of high densities the distances between owls on the same transect were measured. The mean $\pm$ standard error (se) distance of 22 intervals between owls on Sandy Point in 1974 was 5.2 ± 0.9 km (3.2 ± 0.5 mi) with a range of 0.4-15.6 km (0.2-9.7 mi). Similarly the mean $\pm$ se for 30 intervals between owls on Eglinton in 1973 was 5.5 ± 0.7 km (2.3 ± 0.4 mi) with a range of 0.8-14.4 km (0.5-8.9 mi). In 1974 the mean $\pm$ se distance and range of 8 intervals between owls on Eglinton was lower: 3.9 ± 1.4 km (2.4 ± 0.9 mi), 0.4-11.6 km (0.2-7.2 mi).

The only previous count of owls on the area studied was during the summer of 1961 (Tener 1963). While flying aerial transects spaced 6.4 km (4 mi) apart, Tener (1963) saw 6 owls on Eglinton and 51 on Melville west of 111° W, of which 36 were on the Dundas Peninsula. He saw only 3 on the part of Melville east of 111° W. He did not survey Byam Martin.

There are no comparable data for owls on the western Queen Elizabeth Islands from 1961 to 1972 although ground estimates were made between 1968 and 1971 (Taylor 1974b) during a study on Bracebridge-Goodsir lowlands, central Bathurst Island. Taylor noted irregular fluctuations in the numbers of owls on his study area (54 km², 21 sq mi). The density was higher in 1969 than in 1968, 1970, or 1971. In 1969, the year of greatest abundance of lemmings (*Dicrostonyx groenlandicus*), 15 pairs of owls nested and 13 pairs completed clutches. In 1971 only one breeding pair was found, and no eggs hatched. No nesting owls were found in either 1968 or 1970. Snow cover records for 1965-74 from the weather station at Resolute Bay, Cornwallis Island (Atmospheric Environmental Service), show that snow cover in 1968-69 was below the nine-year average and the lowest of the four winters during Taylor's study.

The fluctuations in owl numbers and their differences in phasing in different areas are most likely related to variations in lemming densities. Lemmings were scarce on Melville in 1972 but abundant in 1973. In the latter year fresh diggings at burrow entrances were noticeable in all strata after each rainfall, and lemmings were readily seen at camps and fuel caches. During the spring of 1974, lemmings appeared numerous near our camp on the Sabine Peninsula, but their numbers decreased rapidly during the prolonged snow melt in June and July. Similar observations were made on Bailey Point (Cape Russell) in 1974 (G. R. Parker pers. comm.) and in the Bracebridge-Goodsir Inlet area of Bathurst Island (D. A. Gill pers. comm.). Taylor (1974b) found that lemmings were the commonest prey item, 90 percent by volume, in most Snowy Owl pellets collected on Bathurst. On Southampton Island, Northwest Territories, lemming population (*D. groenlandicus* and *Lemmus trimucronatus*) peaked in the summer of 1970, and nesting Snowy Owls were abundant (Parker 1974). However, lemming numbers crashed in the winter of 1970-71, and Parker saw no Snowy Owls on the island in the summer of 1971.

The increase in numbers of owls on Eglinton, eastern Melville, and Byam Martin from 1972 to 1973 was probably in response to increased numbers of lemmings in 1973. The increased number of lemmings may have resulted from high survival due to an early spring and rapid snow melt.

Similarly, in 1974 the snow cover may have influenced lemming survival and hence owl numbers. Snow cover on western Melville was lighter and melted faster than on eastern Melville, and that condition may have favored survival of lemmings on western Melville or facilitated the hunting success of the owls or both.

On the western Queen Elizabeth Islands the Snowy Owl appears to be a highly nomadic and an opportunistic species, varying its distribution and breeding according to the numbers of its principal prey. Marked fluctuations in numbers have been described which were not in phase for all areas. This probably reflects regional differences in lemming cycles as well as duration and depth of snow cover. We suggest that an essential factor in lemming survival on the High Arctic Islands of Canada is the duration of springtime snow melt, a prolonged period of slushy, deep snow being unfavorable for lemming survival.

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Table 1
 Number of Owls Seen on Transect and
 Estimated Numbers of Owls on Melville, Eglinton, and Byam Martin islands,
 Northwest Territories, 1972, 1973, and 1974

Survey Area	Owls Observed			Estimated Owls		
	1972	1973	1974	1972	1973	1974
Sabine Peninsula	0	6	0	0	22	0
East Central	2	9	7	9	38	30
Central	0	2	0	0	8	0
West Central	N*	1	N	—	4	—
Dundas Peninsula	20	10	3	79	40	12
Sandy Point	—	2	36	—	8	143
Canrobert Hills	—	5	3	—	20	12
Stevens Head	—	1	3	—	4	12
Cape Russell	—	1	16	—	4	63
Melville—Total	22	37	68	88	148	272
Eglinton	5	56	27	20	111	54
Byam Martin	1	3	0	4	12	0

*Areas identified by dash not surveyed

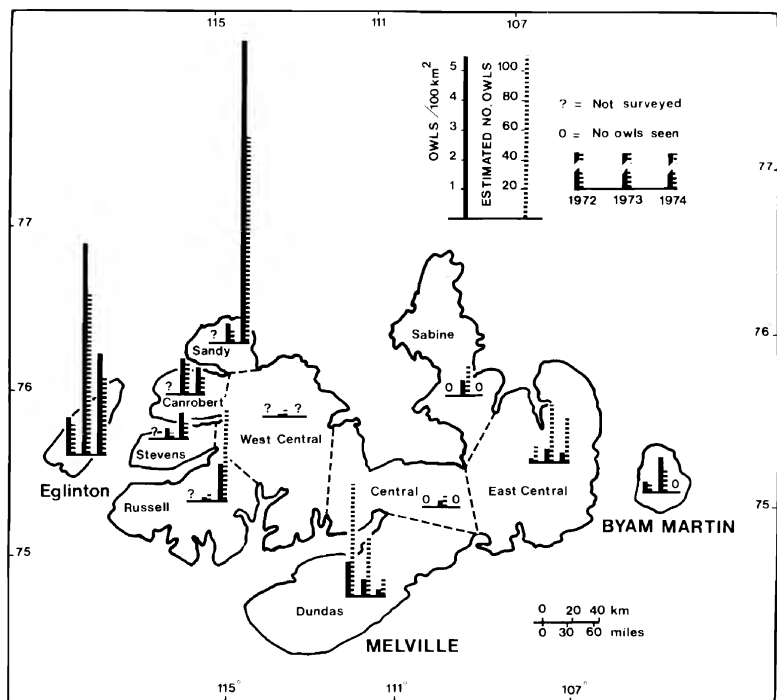


Figure 1. Distribution of Snowy Owls by estimated densities and numbers on Melville, Eglinton, and Byam Martin islands, Northwest Territories, 1972-74.

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